PRESSURIZED VAPOR CYCLE LIQUID DISTILLATION

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Continuation of U.S. patent application Ser. No. 14/942,275, filed Nov. 16, 2015 and entitled Pressurized Vapor Cycle Liquid Distillation, now U.S. Pat. No. 10,179,298, issued Jan. 15, 2019 (Attorney Docket No. Q92), which is a Continuation of U.S. patent application Ser. No. 13/674,559, filed Nov. 12, 2012 and entitled Pressurized Vapor Cycle Liquid Distillation, now U.S. Pat. No. 9,186,598, issued Nov. 17, 2015 (Attorney Docket No. J91), which is a continuation of U.S. patent application Ser. No. 11/927,823, filed Oct. 30, 2007 and entitled Pressurized Vapor Cycle Liquid Distillation, now U.S. Pat. No. 8,307,887, issued Nov. 13, 2012 (Attorney Docket No. F05), which is a Divisional of U.S. application Ser. No. 10/713,617 filed on Nov. 13, 2003 and entitled Pressurized Vapor Cycle Liquid Distillation, now U.S. Pat. No. 7,597,784, issued Oct. 6, 2009 (Attorney Docket No. D91), which claims priority from U.S. Provisional Patent Application 60/425,820, filed Nov. 13, 2002 and entitled Pressurized Vapor Cycle Liquid Distillation (Attorney Docket No. C48), U.S. Provisional Patent Application 60/490,615, filed Jul. 28, 2003, and entitled Systems and Methods for Distributed Utilities (Attorney Docket No. D90), and the U.S. Provisional Patent Application 60/518,782, filed Nov. 10, 2003, and entitled Locally Powered Water Distillation System (Attorney Docket No. E08), each of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to liquid purification, and more particularly to liquid purification by vapor compression distillation comprising a liquid ring pump with rotatable housing having an internal liquid recovery system.

BACKGROUND OF THE INVENTION

[0003] A dependable source of clean water eludes vast segments of humanity. For example, the Canadian International Development Agency reports that about 1.2 billion people lack access to safe drinking water. Published reports attribute millions and millions of deaths per year, mostly children, to water related diseases. Many water purification techniques are well known, including carbon filters, chlorination, pasteurization, and reverse osmosis. Many of these techniques are significantly affected by variations in the water quality and do not address a wide variety of common contaminants, such as bacteria, viruses, organics, arsenic, lead, mercury, and pesticides that can be found in water supplies in the developing world and elsewhere. Some of these systems require access to a supply of consumables, such as filters or chemicals. Moreover, some of these techniques are only well suited to centralized, large-scale water systems that require both a significant infrastructure and highly trained operators. The ability to produce reliable clean water without regard to the water source, on a smaller, decentralized scale, without the need for consumables and constant maintenance is very desirable, particularly in the developing world.

[0004] The use of vapor compression distillation to purify water is well known and can address many of these concerns. However, the poor financial resources, limited technical assets, and low population density that does not make it feasible to build centralized, large-scale water systems in much of the developing world, also limits the availability of adequate, affordable, and reliable power to operate vapor compression distillation systems, as well as hindering the ability to properly maintain such systems. In such circumstances, an improved vapor compression distillation system and associated components that increases efficiency and production capability, while decreasing the necessary power budget for system operation and the amount of system maintenance required may provide a solution.

SUMMARY OF THE INVENTION

[0005] In a first embodiment of the invention there is provided a liquid purification system is provided that advantageously may be compact, inexpensive, and easily maintained. One embodiment has a distillation device with a liquid ring pump and a fully rotatable housing with a single continuous shaft about which the liquid ring pump, motor and rotor rotates, and a second shaft supporting the rotatable housing, with an internal or external combustion engine, preferably having motor rotor and magnets hermetically sealed within the fluid pressure boundary of the distillation system.

[0006] Another alternative embodiment has a distillation device with a liquid ring pump encased in a fully rotatable housing within the head vapor space of a still. Systemic heat sources can be redirected through a multi-line heat exchanger to maximize energy efficiency during the vaporization step. Back-wash lines may be directed to the intake from the head chamber of the evaporator/condenser, to keep unique flip-filters in the intake from fouling and to add heat into the heat exchange network. Further, a method of eliminating mist may be incorporated in the liquid ring pump component to eliminate contaminated liquid droplets entrained in the vapor and prevent them from being carried along to the condenser and thereby contaminating the purified product.

[0007] Another particular embodiment has a distillation device with a liquid ring pump and a fully rotatable housing with a single continuous shaft about which the liquid ring pump, motor and rotor rotates, and a second shaft supporting the rotatably housing, with an internal or external combustion engine and siphon pump in a lower reservoir to siphon liquid into the chamber of the liquid ring pump. The result is a highly efficient, easily accessed and maintained, relatively simple and inexpensive system for purifying a liquid.

[0008] Yet another is a method for removing contaminants from water comprising driving an electric generator by means of a thermal cycle engine for generating electrical power capacity, the thermal cycle engine including a burner for combusting a fuel, employing at least a portion of the electrical power capacity of the electric generator for powering a water purification unit, supplying source water to an input of the water purification unit, conveying heat output of the thermal cycle engine for supplying heat to the water purification unit to reduce the amount of electrical power required to purify the water. Further embodiments may additionally comprise one or all of transferring heat from an exhaust gas of the burner to source water, heating an enclosure surrounding the water purification unit to reduce